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In re patent application of:

OGMEN, Melih and ADAIR, Richard

Serial No.:	10/034,205	Group Art Unit:	2615
Filed:	January 3, 2002	Examiner:	Not Yet Assigned
Title:	METHOD AND APPARATUS FOR OPTICAL DATA TRANSMISSION		

Assistant Commissioner for Patents
Washington, D.C. 20231

CERTIFIED COPY OF PRIORITY DOCUMENT 35 U.S.C. 119(b)

Sir:

The benefit of the filing date in Canada of a patent application corresponding to the above identified application, has been claimed under 37 C.F.R. 1.55 and 35 U.S.C. 119 in accordance with the Paris Convention for the Protection of Industry Property. A certified copy of the corresponding Canadian Patent Application bearing Serial No. 2,330,195, filed January 3, 2001, is submitted herewith.

Respectfully submitted,

_____
May 17, 2002
Date

_____
John R.S. Orange
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ments déposés au Bureau des brevets. the Patent Office.

Specification and Drawings, as originally filed, with Application for Patent Serial No:
2,330,195, on January 3, 2001, by **MELIH OGMEN AND RICHARD ADAIR**, for
"Multi Wavelenght Coding for Digital Signal Processing".

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Agent certificateur/Certifying Officer

April 9, 2002
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Date

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(CIPO 68)
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MULTI WAVELENGTH CODING
FOR DIGITAL SIGNAL PROCESSING.

Historically a "bit" is defined as "unit of information expressed as choice between two possibilities" whereas a byte is defined as a group of binary digits. A byte can consist of any number of bits. Traditionally a byte was referred to as a group of 8 bits. Today the term byte fell into disuse and transmission of information a between two physical points are referred to in units of bits of information. The number of bits that defined the byte group gradually increased from 8 to 16 to 32 to 64. It is highly likely that in the future this number will keep increasing.

The invention relates to a method of increasing the transmission speed of information between two or more points by redefining a new single unit of information.

The two states of a bit were originally identified as state "1" denoting existence of electric potential at a given point and the state "0" as not having the said potential at that point.

With the advent of laser based fibre optic communications technology there is no underlying reason to adhere to the earlier definition of a bit since lasers can emit at many different wavelengths. Therefore it is now possible to define a "rich bit" having multitude of states as opposed to only two. It now is possible to define each bit as an entity with a depth characteristic. Under this definition, a conventional bit depth would be 1. A rich bit can have a depth of any integer number. The depth of a rich bit will be limited not by theoretical boundaries but technological and economical factors.

This change in the basic concept of definition of a bit from a conventional to a rich bit, will have an enormous effect on the information that can be carried within communication networks, computers and other devices that need to interact with each other.

A conventional 8-bit unit has 256 distinct combinations since each bit has only two distinct states. The number of distinct combinations increases dramatically when the number of bits comprising a unit is increased. A 16-bit unit has 65,536 and a 32-bit unit has 4,294,967,296 combinations.

If a "bit" can have more then two intrinsic states then the number of distinct combinations that can be achieved per unit of information literally explodes. For example if a "bit" can have four states then an 8 bit unit will have 65,536 and a 32-bit unit 18,446,744,073,709,551,616 distinct combinations. For a 32-bit communication unit, a small change in the available states of the "bit" (from two to four) translates into an increase by a factor of approximately 4.3 billion in the number of distinct combinations available.

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Another way of looking at the advantages of the rich-bit coding scheme proposed herein is as follows. If a given application necessitates a 32 bit transmission rate using a two state definition of a bit, the same information content can be transmitted using an 8 rich-bit coding technique by using 15 wavelength deep bits. Potential reduction of information package width from being 32 down to 8 without loosing information content provides significant benefits:

- For a given pulsing rate from a communication laser, there will be a significant savings in the transmission time by moving to rich bit based coding.

- If the transmission time is held constant, then using a rich bit based coding, the same information content can be generated at much slower laser pulse rates (hence cheaper, longer life time etc.) from the communication lasers.

As stated earlier, in the rich-bit based coding system, each bit has many states (i.e. bit depth). A given state of a rich bit can be defined by a distinct wavelength from a laser or another optical source. In case of non optical communications within computers or other electronic devices these distinct states of a bit can be distinguished by separating the states using different frequencies, voltage levels etc.

In the rich bit coding scheme outlined in this document a communication unit might then be represented as shown in figure 1 where each column represents a bit and λ_x values for each bit indicate specific states associated with that bit. In this example the bit depth will then be n-1.

$$\left\{ \begin{array}{cccccc} \lambda_0 & \lambda_0 & \lambda_0 & . & . & \lambda_0 \\ \lambda_1 & \lambda_1 & \lambda_1 & . & . & \lambda_1 \\ \lambda_2 & \lambda_2 & \lambda_2 & . & . & \lambda_2 \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ \lambda_n & \lambda_n & \lambda_n & \lambda_n & \lambda_n & \lambda_n \end{array} \right\} \quad \text{Figure 1}$$

The numerous wavelengths, which comprise the individual states of a "bit", can be obtained as follows:

For the sake of simplicity lets assume that a "bit has four distinct states. These can be represented with three wavelengths and a lack of emission (i.e. zero state)
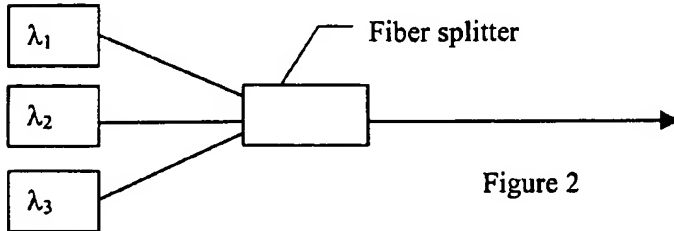

Figure 2

The wavelengths comprising a communication unit can then be split and detected at the other end of the communication fibre by already established techniques and existing DWDM (Dense Wavelength Division Multiplexing) hardware.

A common laser driver can drive the lasers shown in figure 2. Though the lasers are shown as three individual lasers it is also possible to manufacture them on a common substrate with slightly varying energy gap levels by locally varying the doping levels. In this case it will be possible to emit three (or more) wavelengths from a single solid-state device. This scheme can be represented as shown in figure 3 below.
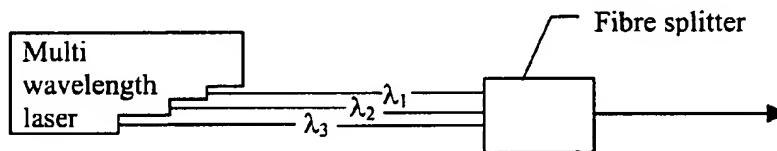

Figure 3

If the line width of the laser allows or if another relatively broad band emitter is used, then it will also be possible to have a configuration as shown figure 4
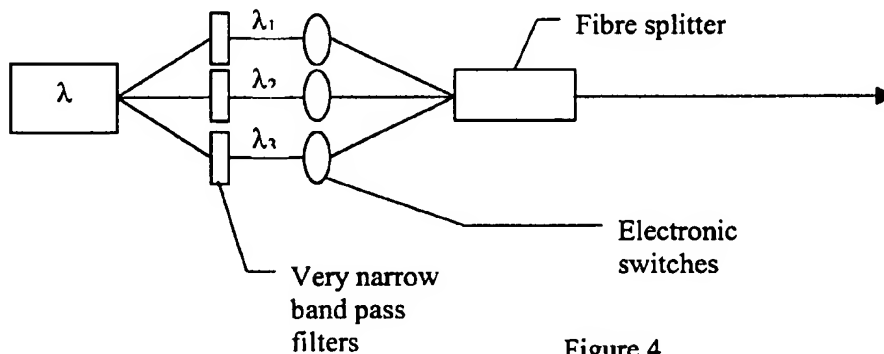

Figure 4

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In this approach the line width (FWHM) of the laser (or the other optical source) can be optically separated into multitude of individual wavelengths with the use of very narrow band pass filters or other similar devices.

In the scheme that is shown in figure 4 the laser source can be operated either in the continuous wave mode or in the pulse mode. In the pulse mode operation, the pulsing of the laser needs to be synchronized with the electro-optic switches on individual wavelength branches.

One of the approaches described above or more generally the rich-bit coding system can also be used with the existing DWDM networks where several sub wavelengths for the bit depth necessary can be established around each DWDM channel.

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